

LETTERS

Remediating Rocky Flats

IN THEIR POLICY FORUM "AVOIDING DESTRUCTIVE remediation at DOE sites" (12 Mar., p. 1615), F. W. Whicker and colleagues applaud the "risk-based" cleanup of U.S. Department of Energy (DOE) sites and point to Rocky Flats near Denver as a success story. Unfortunately, various assumptions about risk as well as certain features of the Rocky Flats cleanup show the risk-based approach to be seriously flawed.

Those who assess risk and set radiation exposure standards have systematically excluded affected populations from every step of the process. Risk calculation, particularly as encoded in U.S. standards, is weighted against the most vulnerable populations.

Image not
available for
online use.

The Rocky Flats nuclear weapons plant in 1979. The Rocky Flats site is undergoing cleanup by the Department of Energy.

Rocky Flats will become a wildlife refuge after cleanup. Thus, the plutonium-contaminated site is being cleaned on the surface to protect wildlife refuge workers. The DOE will rely on not-yet-specified institutional controls to contain larger quantities left below a depth of 3 feet. The National Academy of Sciences says such controls will not last (1). Given the 24,400-year half-life of plutonium, the Rocky Flats cleanup is a short-term response to a long-term problem. Whicker *et al.* say "natural attenuation" will take care of smaller concentrations left behind. But plutonium left in the environment constitutes an essentially permanent danger in particles too small to see but not too small to inhale, ingest, or otherwise take into the body. Although Whicker *et al.* are sanguine about wildlife, genetic effects on such populations are poorly understood.

Whicker and his colleagues say risk-based cleanup will save money. A closed-door decision that imposed fiscal limits on activities at Rocky Flats made cost, not risk, the real driver for cleanup. No one can predict what costs, monetary and otherwise, future generations may face. Contrary

to Whicker and colleagues' comments, what is happening at Rocky Flats sets a poor precedent for other sites.

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Reference

1. T. Leschine *et al.*, *Long-Term Institutional Management of U.S. Department of Energy Legacy Waste Sites* (National Academies Press, Washington, DC, 2000).

Response

IN OUR POLICY FORUM, WE POINTED TO THE Rocky Flats Environmental Technology Site as a case where a portion of a plutonium-contaminated but ecologically valuable grassland ecosystem was spared from costly and damaging remediation because of congressional legislation converting much of the site to a wildlife refuge. This meant that cleanup standards were based on a less stringent scenario, namely, a wildlife refuge worker, rather than a site resident.

Moore states that "[t]hose who assess risk and set radiation exposure standards have systematically excluded affected populations from every step of the process." In the case of Rocky Flats, a Citizens Advisory Board (www.rfcab.org/PI.html) and several other organizations have sought to involve and inform the local public and to provide opportunities for public input to cleanup criteria and environmental decisions at Rocky Flats. We also cannot agree with Moore's blanket statement that "[r]isk calculation, particularly as encoded in standards, is freighted against the most vulnerable populations." In our experience, when precise knowledge is lacking, worst-case assumptions erring toward the side of conservatism tend to be the rule, rather than the exception, in setting governmental radiation protection standards and in risk assessments related to development of cleanup criteria.

Indeed, we endorse most of the broad principles about the need for effective public involvement as outlined in a recent article co-authored by Moore (1). Our main argument is that the cleanup process itself can also create human health risks by mobilizing contaminants to air and water and causing construction accidents, as well as producing environmental degradation and instability at both the cleanup and disposal sites.

Moore also states that "plutonium left in the environment constitutes an essentially permanent danger..." The danger is related to the concentrations in the environment and the amounts that get into and decay in the body, not just the fact that it is there. Plutonium from

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historic nuclear weapons testing fallout, and naturally occurring radioactivity exist in soil virtually everywhere on Earth's surface. Potentially, there is a small risk from this natural radioactivity and from the very small amounts of plutonium that may be left in soil after cleanup. We argue that it may not be physically or economically possible to remove the plutonium or natural radioactivity from soil everywhere, but even if it were, such removal is not risk free. The question thus becomes one of where to draw the line between engineered cleanup that can spread risks to a larger population and leaving the material in place where it can be effectively managed.

We believe that risk-based cleanup will save money and that, underpinned by the honest and credible application of sound scientific knowledge, it can prevent unjustified soil excavation, preserve valuable ecosystems, and provide ample protection of human health and the environment. Also, federal commitments are in place that ensure periodic assessment of site conditions and the goal of protecting future generations (2).

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References

1. L. Ledwidge et al., *Health Phys.* **87**, 293 (2004).
2. U.S. Environmental Protection Agency, "Comprehensive five-year review guidance" (EPA 540R01007, EPA, Washington, DC, June 2001).

Net Environmental Benefit Analysis

IN THEIR POLICY FORUM "AVOIDING destructive remediation at DOE sites" (12 Mar., p. 1615), F. W. Whicker *et al.* state, "[W]e are aware of no specific protocol or set of criteria to identify and promote the preservation of ecologically valuable, but slightly contaminated, sites" and "[i]f the criteria of size, ecological value, current risk associated with land use, and projected risk reduction through natural attenuation were established, [the policy of risk-based end states] could be more uniformly administered." A decision framework for comparing net environmental benefits of multiple risk management alternatives for chemical contamination, including remediation, ecological restoration, and natural attenuation, is available, although it has not been endorsed by DOE (1, 2).

Principles of net environmental benefit analysis (NEBA) have been used in the

context of oil spill remediation since the Exxon-Valdez spill (3), and comparisons of ecological states (i.e., injured and restored) are regularly undertaken in determinations of compensatory restoration in Natural Resource Damage Assessments (4). NEBA is consistent with guidance from the U.S. Environmental Protection Agency to "weigh... ecological effects of active remediation alternatives and passive alternatives when selecting a final response" [(5), (pp. 6-7)] and with DOE's emphasis on risk-based end-states. The comparison of alternative ecological states should be supported by additional R&D of nonmonetary valuation methods such as Habitat Equivalency Analysis (4), nonconservative (6) ecological exposure-response models for chemical contamination and physical disturbance, and dynamics of ecological recovery. Moreover, even if future land use plans permit residential developments on land that is slightly contaminated, it may be appropriate to balance the reduction of ecological versus human risk, including risk from proposed remediation (7).

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References and Notes

1. R. A. Efroymsen *et al.*, "A framework for net environmental benefit analysis for remediation or restoration of petroleum-contaminated sites" (ORNL/TM-2003/17, Oak Ridge National Laboratory, Oak Ridge, TN, January 2003) (available at www.esd.ornl.gov/programs/ecorisk/documents/NEBA-petrol-s-report-RE.pdf).
2. R. A. Efroymsen *et al.*, *Environ. Manage.* **34**, 315 (2004).
3. NOAA Hazardous Materials Response Branch, "Excavation and rock washing treatment technology: net environmental benefit analysis" (National Oceanic and Atmospheric Administration, Seattle, WA, 1990).
4. NOAA Damage Assessment and Restoration Program, "Habitat equivalency analysis: an overview" (National Oceanic and Atmospheric Administration, Seattle, WA, 2000).
5. S. D. Luftig, "Issuance of final guidance: ecological risk assessment and risk management principles for Superfund sites" (OSWER Directive 9285.7-28, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, DC, 1990).
6. Nonconservative so that unbiased comparisons can be made.
7. G. W. Suter II *et al.*, *Risk Anal.* **15**, 221 (1995).

Response

WE APPRECIATE EFROYMSON'S COMMENTS concerning the application of "net environ-

Letters to the Editor

Letters (~300 words) discuss material published in *Science* in the previous 6 months or issues of general interest. They can be submitted through the Web (www.submit2science.org) or by regular mail (1200 New York Ave., NW, Washington, DC 20005, USA). Letters are not acknowledged upon receipt; nor are authors generally consulted before publication. Whether published in full or in part, letters are subject to editing for clarity and space.

mental benefit analysis" for making decisions on the management of contaminated sites within the DOE nuclear weapons complex. We are not presently in a position to offer critique or endorsement of the specific frameworks and approaches referenced by Efroymson. However, we encourage DOE to investigate the merits of such concepts with the goal of achieving cleanup decisions that provide optimal protection of both human health and environmental quality.

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Support for Steiger's Policies

JOCELYN KAISER'S ARTICLE ON WILLIAM Steiger, the point person on international health for U.S. Health and Human Services (HHS) Secretary Tommy Thompson ("The man behind the memos," *News Focus*, 10 Sept., p. 1552), is decidedly one-sided. She

interviewed me at length, and although I support his policies and admire his professionalism, none of my views, or those of other supporters, are mentioned.

Scientists cry "academic freedom" when their travel is cut, as happened with the AIDS conference in Bangkok. Steiger, as well as journalists and health experts, knew this conference had become unruly and unproductive (1).

Kaiser writes that Steiger's support of the Bush administration's "controversial" position on abstinence in HIV prevention programs "ruffled feathers" among researchers. She neglects to mention how promotion of abstinence is dramatically reducing HIV/AIDS infections in Uganda (2).

Furthermore, Steiger is doing his job when refusing to fund any conference that undermines the administration's approach to procuring safe and effective AIDS drugs. Kaiser fails to mention how the administration's position has been supported by the World Health Organization's (WHO) removal of five AIDS drugs from its list because of unproven quality. South Africa has banned at least one of the drugs that the Administration refused to buy until tested.

The fact that Steiger approves HHS staff involvement in WHO activities may upset

some researchers. Yet all government agencies routinely approve which researchers attend meetings as U.S. representatives. It is Steiger's job to coordinate the U.S. position with inputs from many agencies with expertise most appropriate for any particular conference. He does this job in the best interests of the country, and does it well.

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References

1. For example, see these op-ed pieces: S. Mallaby, "AIDS activists misfiring," *Washington Post*, 18 July 2004, p. A17; L. Garrett, "Bragging in Bangkok," *N.Y. Times*, 16 July 2004, p. A21.
2. E. C. Green, *Rethinking AIDS Prevention* (Praeger, Westport, CT, 2003).

The Gulf of Mexico's Dead Zone

DAN FERBER'S NEWS FOCUS "DEAD ZONE FIX not a dead issue" (10 Sept., p. 1557) gives too much credence to assertions that reducing nitrogen pollution would not shrink the extent of hypoxia in the Gulf of Mexico. The EPA report focuses solely on ratios of concentrations of dissolved inorganic nitrogen (DIN)

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and dissolved inorganic phosphorus (DIP), mainly in the lower Mississippi River, to suggest that inputs of phosphorus could control phytoplankton production on the continental shelf and, thus, the scale of summer hypoxia.

Decomposition of plankton biomass along the inner shelf west of the river mouth depletes dissolved oxygen in the denser bottom waters. In the spring and early summer, plankton biomass accumulates in surface waters enriched with DIN but often with extremely low DIP concentrations. If

there were severe phosphorus limitation, how can this biomass be grown? Almost certainly, it is because there are other phosphorus sources, including recycling from organic material, large reservoirs in bottom sediments, and the deeper Gulf of Mexico. Surface-water organisms rapidly take up any DIP supplied, keeping DIP concentrations very low, indicating that DIN:DIP ratios are notoriously unreliable indicators of nutrient limitation (1). These other phosphorus sources may be unconnected or indirectly connected to seasonal river inputs and, thus, may prove

difficult if not impossible to control.

More comprehensive assessment strongly indicates that nutrient pollution, particularly in the form of nitrogen from Mississippi Basin agriculture, is the principal cause of hypoxia and that improved agricultural practices coupled with restoration of wetlands in the river basin are the only solutions (2). With better understanding, it might prove effective to reduce both nitrogen and phosphorus inputs as is being pursued elsewhere (3), but a solid body of science indicates that substantial reductions in nitrogen loads are required to reduce the extent of hypoxia (4) and, further, that curtailing phosphorus without reducing nitrogen inputs might actually extend the effects of overenrichment to a larger area (5, 6).

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3. D. F. Boesch, *Estuaries* **25**, 886 (2002).
4. D. Scavia, D. Justić, V. J. Bierman, *Estuaries* **27**, 419 (2004).
5. H. W. Paerl, L. M. Valdes, A. R. Joyner, M. F. Piehler, *Environ. Sci. Technol.* **38**, 3068 (2004).
6. J. D. Hagy, W. R. Boynton, C. W. Keefe, K. V. Wood, *Estuaries* **27**, 634 (2004).

TECHNICAL COMMENT ABSTRACTS

COMMENT ON "The Origins of Genome Complexity"

Vincent Daubin, Nancy A. Moran

Lynch and Conery (Reports, 21 November 2003, p. 1401) claim a universal relation between genetic population size and genomic size and complexity, but their treatment of bacteria is invalid. Their estimates of polymorphism for bacteria largely reflect evolutionary divergence of independent clonal lineages rather than selection efficiency within cohesive species. An alternative measure of genetic drift shows no relation to genome size.

Full text at www.sciencemag.org/cgi/content/full/306/5698/978a

RESPONSE TO COMMENT ON "The Origins of Genome Complexity"

Michael Lynch, John S. Conery

Daubin and Moran claim that prokaryotes do not have larger effective population sizes than eukaryotes, and also argue that genetic drift is a minor force in prokaryotic genome evolution. These arguments are mutually inconsistent and are contrary to a substantial body of empirical and theoretical work.

Full text at www.sciencemag.org/cgi/content/full/306/5698/978b

